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CALIFORNIA HYDRO-ELECTRICITY OUTLOOK FOR 2002

STAFF REPORT

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Introduction

This brief report provides an outlook of water supplies and hydro generation in California for the remainder of 2002. This outlook is based on hydrologic data, analyses and forecasts provided by the California Department of Water Resources (DWR), especially the monthly Bulletin 120 series.[1] It also relies in part on confidential, proprietary forecasts of hydro generation courteously provided by some California utilities, both municipal and investor-owned.

April 1 is the benchmark date for year-to-year comparisons, including snowpack status, runoff estimates, and the amount of water held in storage. April 1 is also an important date for firming up water delivery estimates, subject to revision with the final snow surveys on May 1. The water year begins on October 1. On average, 82 percent of the state's annual precipitation arrives by the end of March.

From 1983 to 2001, hydroelectric generation in California has averaged 37,345 gigawatts per hour (GWh), which is 15.2 percent of the total generation used, including imports, to meet California electricity needs. Hydroelectric generation varied from a high of 29.8 percent in 1983 (a very wet year), to 9.1 percent in 1993, just after the prolonged 1987-1992 drought. The next lowest share from hydro generation was 9.6 percent in both 1991 and 1992 during that drought. Last year, which was dry in northern and central California, hydroelectric generation was just 9.8 percent of the state's total supply. The broad trend has been for hydro to account for a smaller share of electricity supplies, as little new capacity has been added in the last 20 years.

On a statewide basis, variations in water supply do not significantly affect dependable capacity for peak demand needs. The amount of water that can be run through hydro plants affects the total amount of energy that can be produced. Hydro electricity generation generally influences the amount of gas-fired generation needed to meet the balance of demand this summer.

Water Supply Outlook

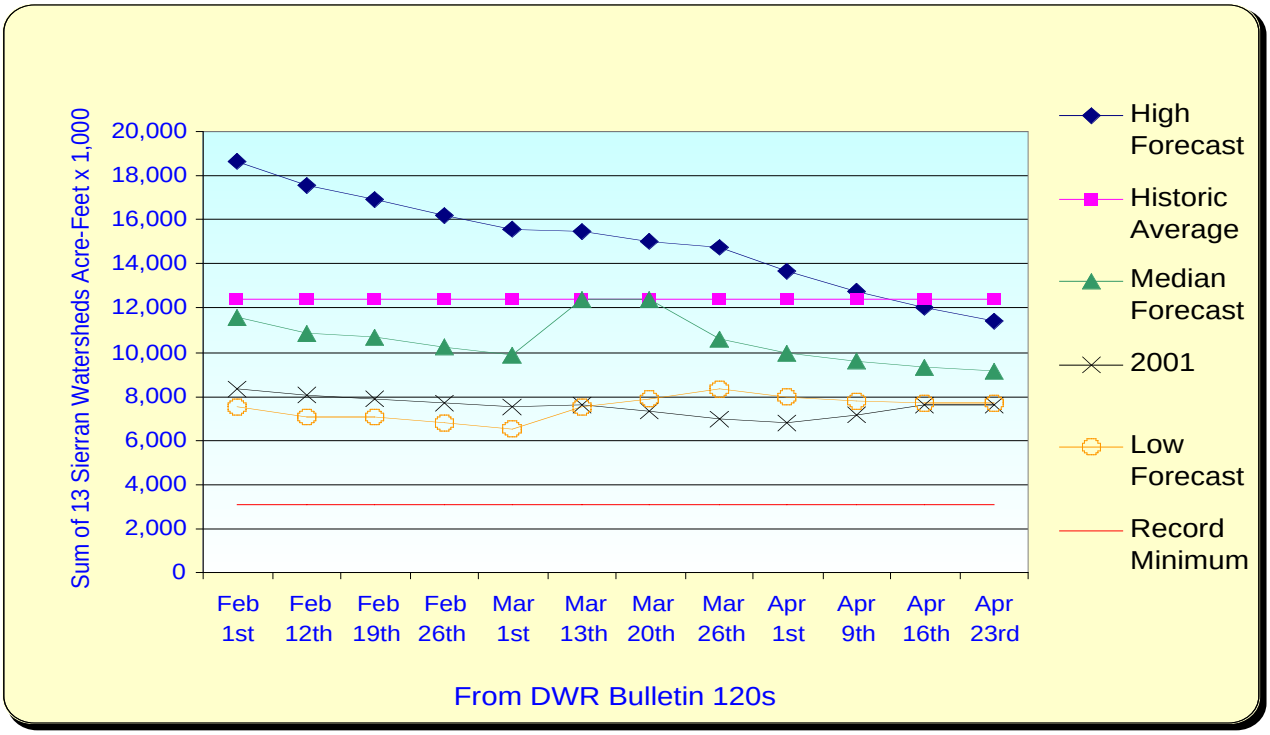
As of April 1, with one month remaining in the six-month rainy season, California water supplies are expected to be 80 percent of average. This calculation is based on data from 50 years, from 1951 through 2000. Statewide precipitation has been 85 percent of average, much above last year's 75 percent. The snowpack water content this year is 95 percent of average compared to 60

[1] "Summary of Water Conditions, April 1, 2002" published as *Bulletin 120* by the California Department of Water Resources (DWR). Posted on the web at [http://cdec.water.ca.gov/snow/bulletin120/b120apr02.pdf].

percent a year ago. Reservoir storage is roughly 100 percent of normal for this date, up slightly from last year.

The vast majority of in-state hydro energy generation depends on the runoff in 13 rivers that flow into the Sacramento River, San Joaquin River, and Tulare Lake basin. These 13 rivers, including the California Aqueduct that draws from the Delta, have a total dependable capacity of 11,604 megawatts (MW). This level is about 88 percent of the state's 13,168 MW total, but does not include QFs or Hoover entitlements. On these 13 rivers, from the Upper Sacramento River to the Kern River, runoff for April through July was forecast to be about 80 percent of average, 9.296 million acre-feet as shown in **Figure 1**. This "median forecast" is much higher than last year's 50 percent. **Figure 1** shows how this forecast has changed weekly since February 1. The "low forecast" has a 90 percent chance of being met. The "high forecast" has a 10 percent chance of being met.

Figure 1. Runoff Forecast April 23, 2002



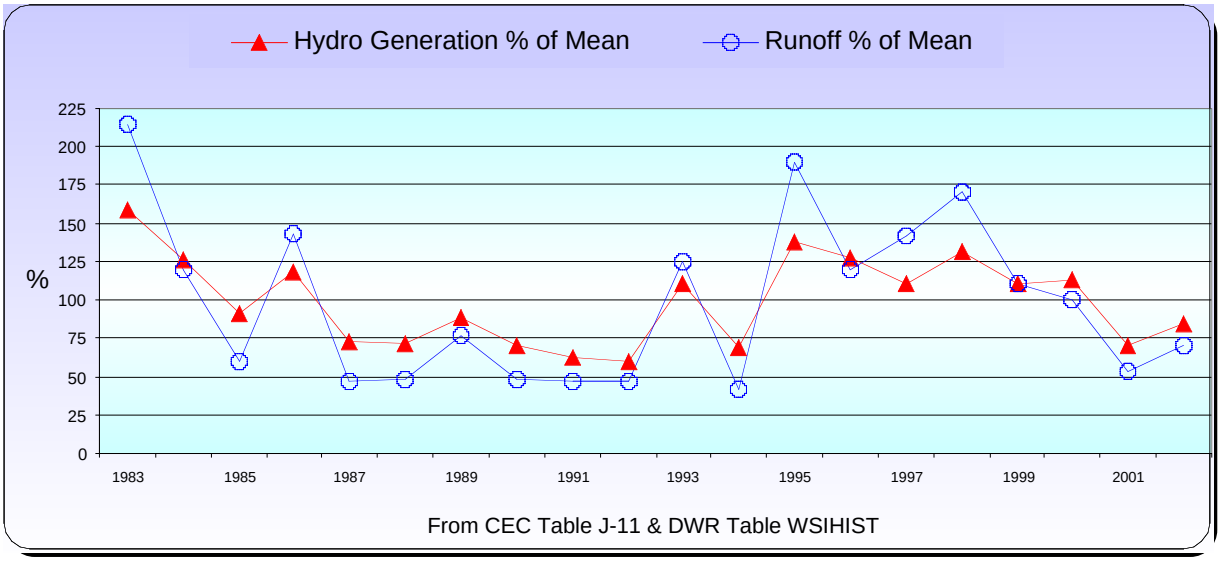
Since April 1, 2002, estimates of statewide river volume runoff have continued to decline. The Sacramento Valley water year is now classified as "below normal," and the San Joaquin Valley is "dry." Water deliveries are expected to be average or near normal, except for south of Delta agricultural users served by State Water Project (SWP) and Central Valley Project (CVP).

Hydroelectricity Outlook

Hydroelectric energy supplies are forecast to be 85 percent of average. The prospect is for about 31,700 GWh of energy from hydro generation this year, including QFs and Hoover entitlements. The forecast percentage is five points better than the water supply forecast, based on four considerations. Historically, variation in energy generation has been more moderate than the natural vissitudes of water supplies. Reservoirs allow carryover storage from one year to the next (though last year had little surplus water). Dam operators are increasingly skilled at impounding maximum runoff without spillage. Computerized controls and scientific forecasting allow for more optimal storage while maintaining release schedules and managing flood risks. Hydro generation has been significantly more stable than year-to-year changes in weather and river runoff volumes, as shown in **Figure 2**.

In wet years, such as 1983 and 1995, the amount of installed capacity is not adequate to use all available runoff, and some is spilled to maintain flood protection. The yearly water totals can obscure important variations for energy generation. After the January 1997 flood, the months of February through June were extremely dry. So generation in 1997 actually declined from 1996, even though total precipitation increased.

Figure 2. Hydro Generation & Central Valley Runoff

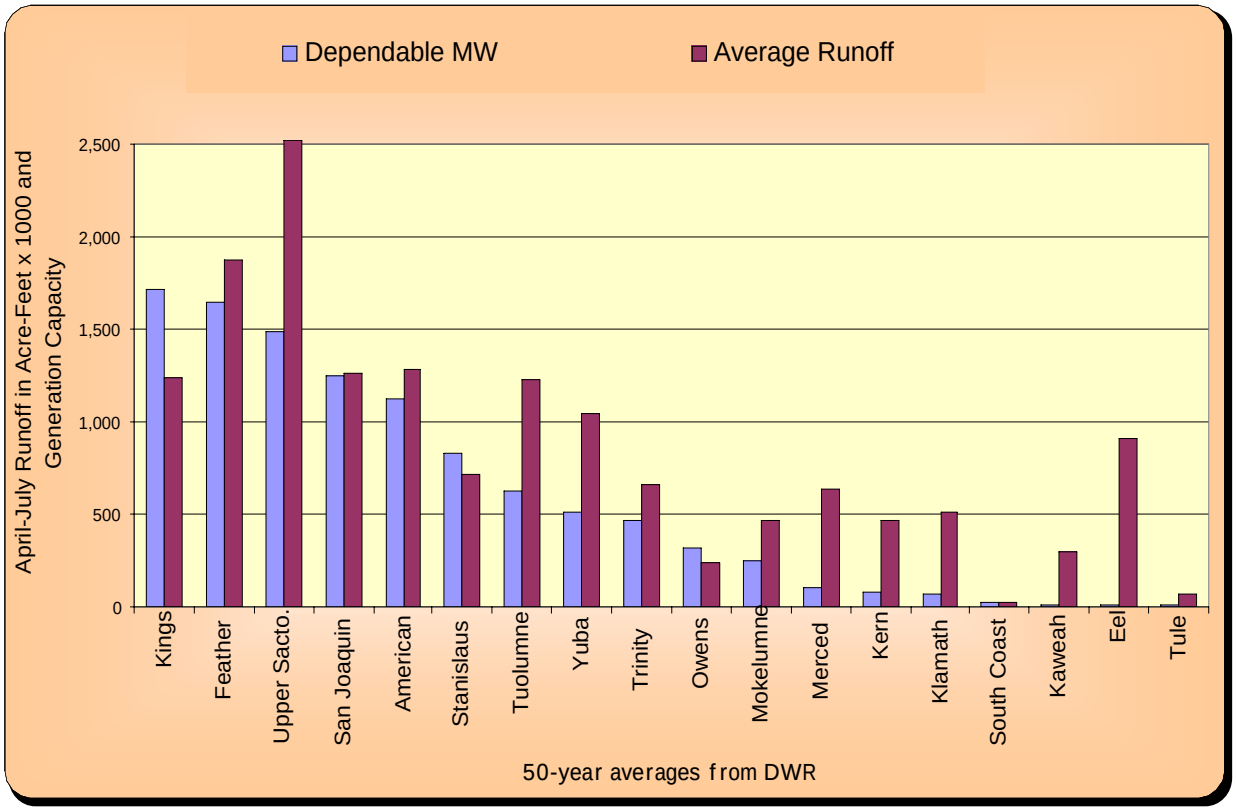


A second factor is the role played by 3,630 MW of pumped storage at seven California plants (Helms, Castaic, Edward C Hyatt, Thermalito, W R Gianelli, O'Neill, and Diamond Valley). While they are net consumers of energy, their output for meeting peak demand is quite reliable. This recycled water is nearly immune to weather changes. By pumping uphill during the night these plants

help to build load in those hours, flattening the daily load curve. Pumping-generating plants increase system-wide economy by using energy from baseload plants that are most efficient when run continuously.

A third factor for predicting 85 percent of average hydro electricity supplies is the unequal distribution of rainfall and snow in California. Water is the fuel source and the limiting factor for most hydro plants. More precipitous falls in the north: roughly 75 percent of the state's precipitation is north of Sacramento, while 75 percent of consumptive water usage is south of Sacramento. Developed hydropower capacity is also more heavily weighted to the north, slightly more so than the precipitation pattern. **Figure 3** shows that river runoff is not proportional to installed dependable capacity on those rivers.

Figure 3. Hydro Capacity on California Rivers



Only the Kings, Stanislaus, and Owens Rivers have more generation capacity than average runoff volumes (thousands of acre-feet). The Kern, Kaweah, and Tule Rivers in the southern Sierra have proportionately far less capacity than runoff. These watersheds received much less precipitation than average. **Figure 3** does not include plants on the Bear River, for which runoff is not calculated, or plants on the California Aqueduct (2,103 MW), Colorado Aqueduct (100 MW), or All-American Canal (85 MW).

The forecast runoff for each watershed was compared to the installed dependable capacity on each river to give a "weighted average" estimate. This estimate provides a statewide forecast for the amount of water expected to flow towards all utility-owned hydro plants in California. The "weighted average" of this year's runoff is 84 percent. Although runoff in 2001 was forecast to be 60 percent of average, the "weighted average" was 65 percent, and actual hydro generation in 2001 was even higher at 70 percent of average (26,062 GWh, from Energy Commission Table J-11). **Table 1** and **Figure 4** below illustrate the importance of comparing precipitation amounts (and the deviation from historic averages) along with installed capacity for generation.

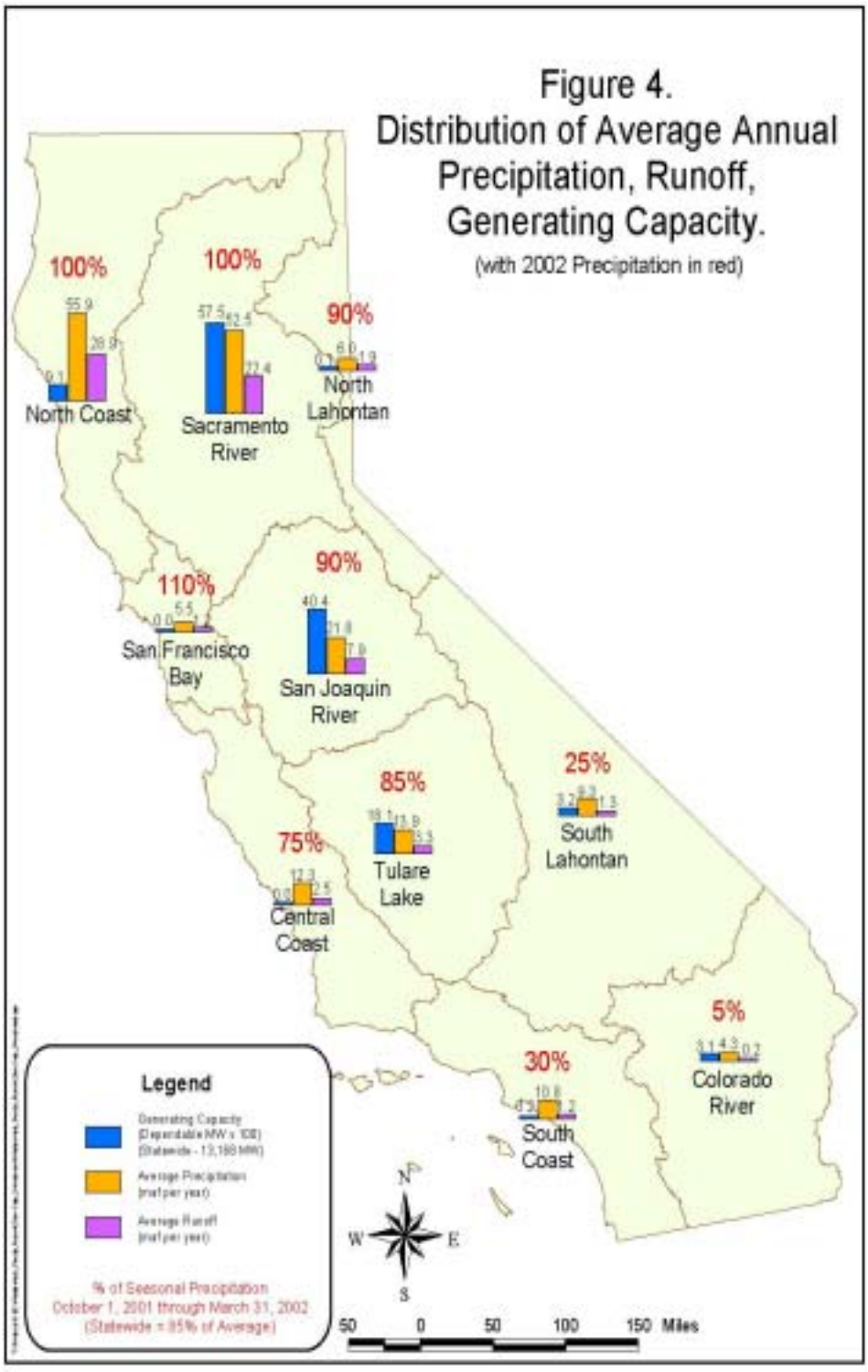
Table 1. Hydro Energy Capacity by Hydrologic Region

Region	MW	2002 Precipitation as percent of Average	Average Precipitation million acre-feet per year	Average Runoff million acre-feet per year
Sacramento River	5,749	100	52.4	22.4
San Joaquin	4,041	90	21.8	7.9
Tulare Lake	1,814	85	13.9	3.3
North Coast	908	100	55.9	28.9
South Lahontan	323	25	9.3	1.3
Colorado	307	5	4.3	0.2
South Coast	20	30	10.8	1.2
North Lahontan	6	90	6.0	1.9
Bay Area	0	110	5.5	1.2
Central Coast	0	75	12.3	2.5

In **Table 1** and **Figure 4**, North Coast includes 365 MW near Redding that is fueled by diversions from the Trinity River. Sacramento River includes 74 percent of 2106.6 MW on the State Aqueduct, which begins with water pumped from the Delta. San Joaquin includes the other 26 percent. South Lahontan includes all capacity on the Los Angeles Aqueducts. The Colorado region includes Parker Dam on the lower Colorado River, but not Hoover entitlements. The Colorado also includes plants on the Colorado Aqueduct and All-American Canal.

For Southern California, 2002 is a "dry" year, with just 30 percent of average rainfall. Fortunately, only about 20 MW of capacity is installed in the South Coast to capture natural runoff near Escondido and in the San Bernadino and San Gorgonio Mountains. On the other hand, having 110 percent of average precipitation in the Bay Area is of no consequence since there are no hydro generation plants in that region.

A fourth consideration for predicting 85 percent of average in-state hydro generation is the storm pattern for the 2001-2002 season. Heavy rains in



December 2001 helped to replenish reservoirs without major releases for flood protection. Rainfall from January through March 2002 was generally below

average, but evenly delivered over time. Cool temperatures, except for the last week of March 2002, have slowed the "ripening" of the snowpack compared to last year.

Two considerations provide a counter-balance against a higher forecast for hydro generation this summer. Very dry weather since April 1 has reduced the weekly runoff estimates by about four percentage points statewide. Secondly, 2002 is the second consecutive year of below average or dry conditions. Although there is not an official drought, the second dry year (as in 1988 and1991) usually has a larger adverse effect on hydropower than the first, by a couple percentage points. To focus on the positive, the state's storage containers are much fuller than last year.

Out-of-State Water Outlook

In 2002, much more hydropower will be available from the Pacific Northwest than last year. In 2001, the states of Oregon and Washington both declared drought emergencies. This year, Washington was heading towards record precipitation totals. It is still relatively early in the northwest water year, with many more rainy days expected. On the lower Columbia River at The Dalles, precipitation is now 97 percent of average. The runoff volume expected is 97.3 million acre-feet, about 92 percent of average. Drought conditions in the upper Colorado Basin are not expected to affect California this year. Although areas above Lake Powell received just 38 percent of average rainfall, the major reservoirs on the Colorado River can hold four years' worth of runoff. A legal "surplus" on the lower Colorado River has been declared, which allows for continued delivery of water to southern California at a normal amount (about 5.2 million acre-feet).

Closing Note

As utility forecasts are made available to Energy Commission staff in the Electricity Analysis Office, these predictions will be refined accordingly in May. The sharing of hydrologic data, analysis, and interpretation, and hydroelectric generation forecasts by several agencies and utilities is gratefully acknowledged.